DIRECTIONS

177667 *Issue* 5

4905 SERIES

CONDUCTIVITY CELLS

4905-1-33-088-7

LEEDS & NORTHRUP

SPECIFICATIONS

CELL CONSTANTS
0.01, 0.1, 1.0, 5, 10, 20, 25, and 50 cm^{-1}.

MOUNTINGS
Insertion Type: Cell has 1" N.P.T. male thread. Depth of insertion is 6 inches (152 mm). Designed for permanent installations.
Immersion Type: Adapts to use of 1/2-inch N.P.T. pipe and a union. Maximum depth of immersion is 6 feet (1.8 m) with standard cable and 19 feet (5.7 m) with 20 foot (6 m) cable.
Flow-Type: The CPVC flow-chamber mounting has 3/4" N.P.T. male for sample inlet and same size female for sample outlet.

MAXIMUM PRESSURE
300 psi at 25 °C.
225 psi at 50 °C.
100 psi at 75 °C.
25 psi at 100 °C.

MAXIMUM TEMPERATURE
Determined by temperature compensator range.

MATERIALS (Wetted Parts)
Electrodes: Platinum or gold-plated nickel.
Cell Body and Mounting Parts: Chlorinated polyvinyl chloride (CPVC)*.

LEADWIRE
PVC covered, 18 gage, 7 feet (2.1 m) or 20 feet (6 m) long.

*Also identified as polyvinyl dichloride (PVDC).

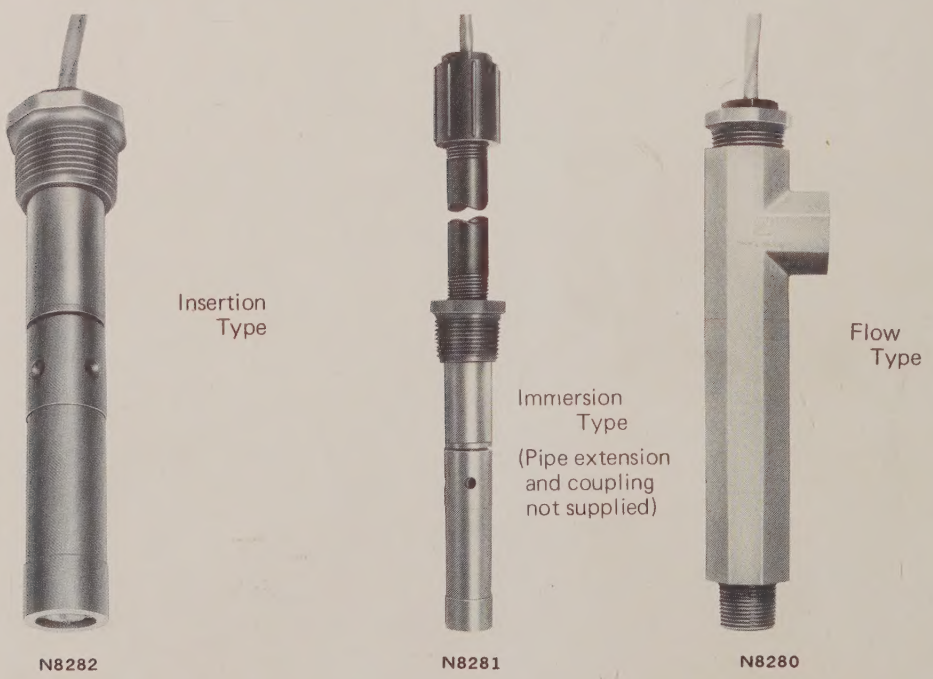


Fig. 1 — Types of mounting for 4905 Conductivity Cells.

4905-10-33-088-7 INSTalbe

4905 SERIES

CONDUCTIVITY CELLS

A B C D

4905-1-33-088-7

1. INTRODUCTION

These cells form the sensing network for industrial monitors and recorders designed to make continuous measurements of electrolytic conductivity. The cells are primarily suited to measurements in effluents of ion-exchangers and distillation columns; but appropriate constants are provided for many other applications, including measurements in micro-electric-component washing and plating-rinse effluents. Universal in mounting, any of the cells can be arranged for immersion, insertion (1" N.P.T.), or flow type sampling. The latter can be achieved by use of a CPVC flow housing, a 1" pipe tee (schedule 40), or 1-1/4" plastic tee (schedule 80) installed in a process line or bypass line as pictured in Fig. 2.

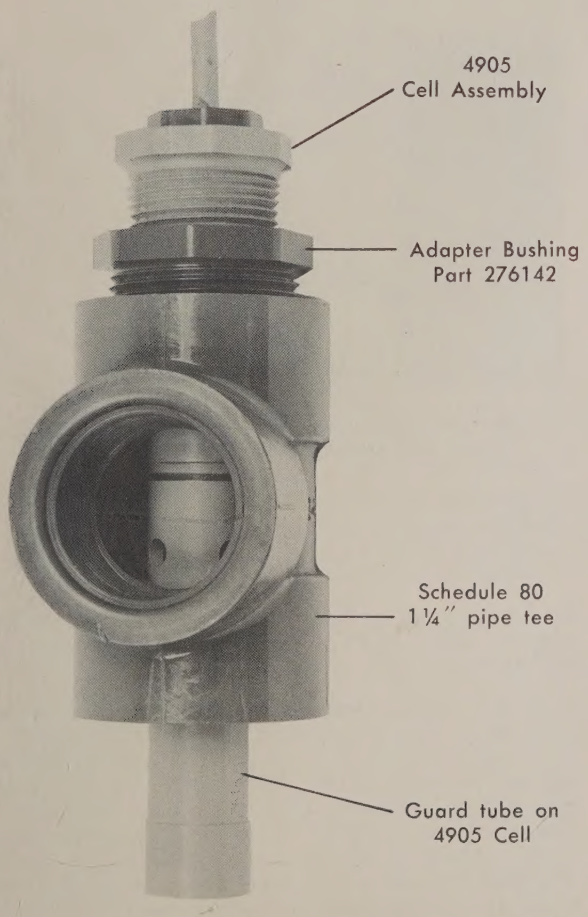


Fig. 2 — 4905 Conductivity Cell mounted in a 1-1/4" schedule 80 tee using the adapter bushing.

TABLE I — CATALOG SUFFIX DESIGNATIONS

4905 — A — B — C — D

SUFFIX A

Cell Constant

0.01	001
0.1	01
1.0	1
5	5
10	10
20	20
25	25
50	50

SUFFIX B

Electrode Material

Gold-plated nickel	33
Platinum	44

SUFFIX C

Temperature Compensation

No integral compensator	00
Integral auto comp. See Tables III, IV and V	

SUFFIX D

Electrical Connections

7 ft. cable	7
20 ft. cable	20

Universal

Head	1

The cell constant is selected according to the range of the measuring instrument used and the solution measured. In general, a high-constant cell is used for solutions having low electrical resistance (high conductivity) and a low-constant cell is used for solutions having high electrical resistance (low-conductivity). The various cell constants available are listed in Table I. Do not use cell constants of 0.01 to 1 if the measured resistance will be less than 1000 ohms. If cells of higher constant cannot be used, it will be necessary to platinize the cell.

Automatic temperature compensation during the measurement is provided by a built-in temperature sensing network located 1-1/2 inches above the cross-channel or guard-tube holes. If fixed or manually adjusted compensation is to be used, this integral compensator is not included. The internal cell and compensator electrical arrangement is shown in Fig. 4. Complete technical data concerning the compensators is given in Appendix A.

The cells are molded from CPVC which is resistant to most corrosive chemicals over a wide range of temperatures. (A common exception is chlorinated hydrocarbons.) Sample solutions come into contact only with the above plastic and the platinum or gold-plated-nickel electrode surface. Any cell can be supplied with either electrode material.

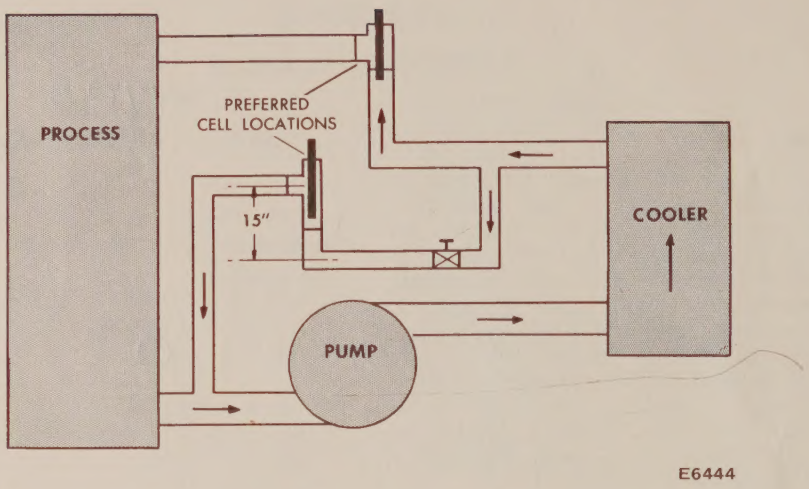


Fig. 3 — Typical conductivity measuring installation. Cell has integral temperature compensation.

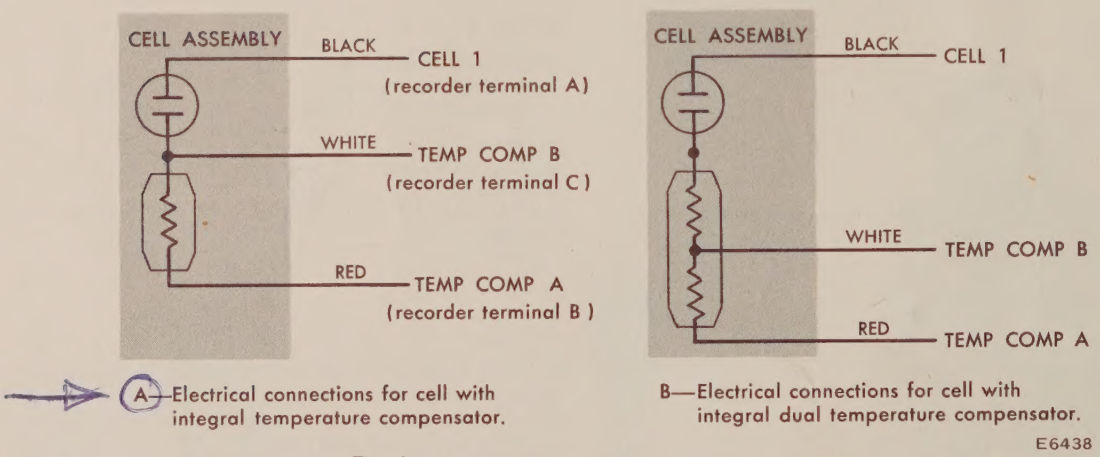


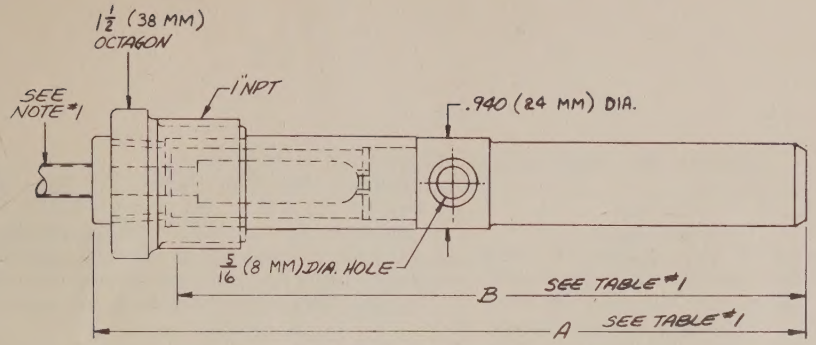
Fig. 4 — Integral temperature compensator circuit and its leadwire terminal-board connections. The dual compensator shown in B is for non-linear ranges.

2. DESCRIPTION

The conductivity cell is secured permanently to the 1" N.P.T. bushing which is used for all types of mountings. The three types of mountings are illustrated in Fig. 1. Although the physical appearance of the various cells is the same (except for length), the cell construction differs according to the constant. On the 10, 25 and 50 constant cells, the electrodes are short tubes located midway inside the two parallel tubular channels that run lengthwise through the cell, and are open to the sample at both ends of the cell. The channels are larger on the 25 constant cell and they are elliptical on the 5 and 10 constant cell. The 1, 0.1, and 0.01 constant cells have a removable cell guard which is screwed onto the cell body to protect the electrode surfaces. Electrodes are three disks on the 1 constant cell, parallel plates on the 0.1 constant cell, and wire wound on the cell body on the 0.01 constant cell. Cells must be used with the guard in place or the cell constant may differ from that specified.

Most of the auxiliary parts which enable the user to achieve the various types of mounting are readily obtained from local suppliers. For an immersion arrangement, only the appropriate length of 1/2 inch pipe (e.g., CPVC) and if desired, a 1/2 inch end coupling is needed. For an in-line flow arrangement, only a 1" schedule 40 tee is required or a 1-1/4" schedule 80 tee with reducing bushing Part 276142. The basic cell can be converted to a flow cell for either bypass or in-line arrangements by use of the CPVC flow-cell housing (L&N Part 276127) shown in Figs. 1 and 3.

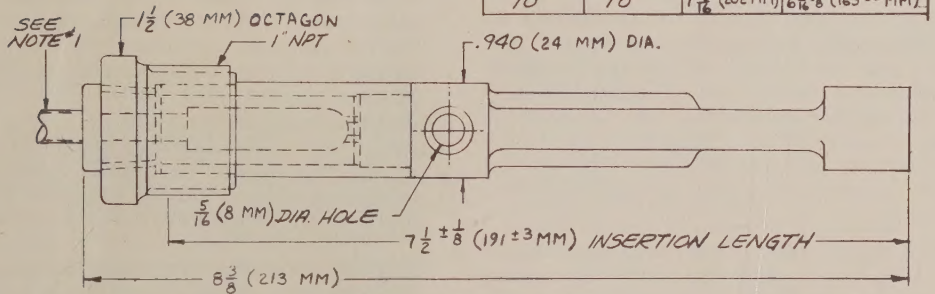
Mounting dimensions for each type of cell assembly are given in Fig. 5.



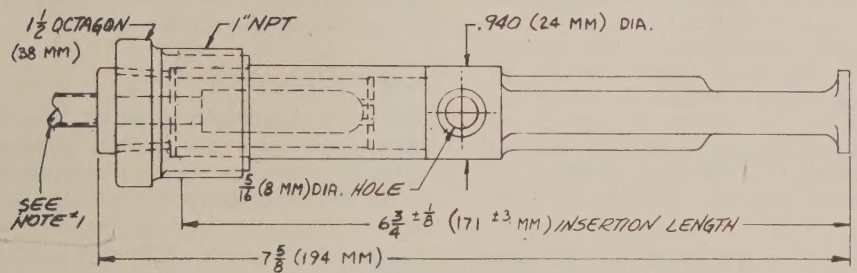
CAT. 4905- 5/10 - 33/44 -□-□ CONDUCTIVITY CELL (5 & 10 CONSTANT)

TABLE #1

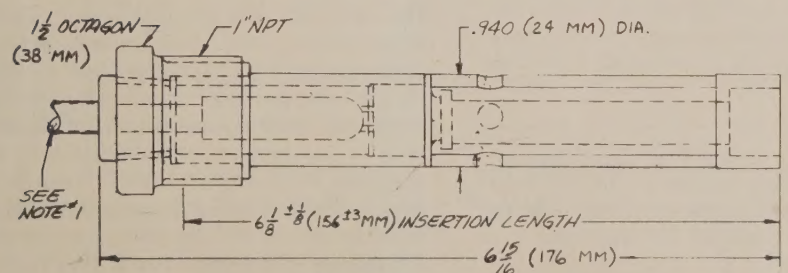
CATALOG NO. SUFFIX "A"	CONSTANT	DIMENSION "A"	INSERTION LENGTH "B"
5	5	6⅛ (156 MM)	5¼ ±⅛ (133 ±3 MM)
5	5	6⅛ (156 MM)	5¼ ±⅛ (133 ±3 MM)
10	10	7 15/16 (202 MM)	6 7/16 ±⅛ (163 ±3 MM)
10	10	7 15/16 (202 MM)	6 7/16 ±⅛ (163 ±3 MM)



CAT. 4905- 25/50 - 33/44 -□-□ CONDUCTIVITY CELL (25 & 50 CONSTANT)



CAT. 4905 - 20- 33/44 -□-□ CONDUCTIVITY CELL (20 CONSTANT)



CAT. 4905- 001/01/1 - 33/44 -□-□ CONDUCTIVITY CELL (0.01, 0.1 & 1.0 CONSTANT)

Fig. 5 — Mounting dimensions.

3. INSTALLATION

3A. Flow-Type Mounting

The cross-channel or guard-tube hole in the cell must always be covered by the solution and if integral compensation is provided, the solution level *must* be 1-1/2 inches above these holes. When mounting the cell in a pipe tee such as shown in Fig. 2, have the solution enter the tee from below and exit to the side. As shown, the guard-tube hole is in line with the horizontal pipe run. However, if it is possible that the pipe line will not be full at all times, locate the hole just below the exit pipe to insure flooding of the cell under all conditions. As shown in Fig. 3, always locate the cell on the pressure side, not the vacuum side of the pump. The flow-cell-housing, an accessory part having 3/4" male inlet and female outlet threads, can be used for an in-line measurement* or in a bypass line as shown in Fig. 3. depending upon the flow volume or pipe size. Adapter bushings are available to convert inlet and outlet fittings to 1/4" female threads. See Section 5C. The cell must be covered by the solution at all times. Therefore, make certain the lowest solution head is higher than the cell location. See that an air bubble does not prevent the cell from filling properly.

To install, tighten the cell into a 1" schedule 40 pipe tee. If a schedule 80, 1-1/4" tee is used, first tighten the bushing (Part 276142) into the tee. If the flow-cell housing is used, assemble the cell and housing and install it in the process flow line or in a bypass line.

3B. Immersion-Type Mounting

The cell must be immersed to a level above the cross-channel or guard tube hole and must be immersed to 1-1/2 inches above this hole if an integral compensator is used. For most immersion applications, a 1/2" support pipe, preferably CPVC must be threaded into the cell bushing, thus permitting adequate immersion. Unless this pipe extension is used, do not immerse the top of the bushing. To insure that a representative sample is measured at all times, the solution must circulate through the channels. In quiescent solutions, provide sufficient agitation.

To install the cell, determine the length of 1/2" pipe required to give the immersion needed to keep the cell completely immersed at all times. Up to six feet of pipe can be used for the standard cell having seven feet of cable. Remove the small bushing at the top of the cell, slide it off the cable, and replace it with the 1/2-inch pipe. At the top of the pipe slide a pipe coupling and the small bushing back over the leadwire as shown in Fig. 1, or install a junction box to terminate the pipe.

3C. Insertion-Type Mounting

The cell can be inserted into a 1" N.P.T. threaded opening, but it is imperative that the tank or chamber be full under all process conditions. Make certain the liquid head is above the cell location. A vertical insertion (from above) or a horizontal insertion can be used.

To install, simply tighten the cell into a 1" N.P.T. threaded opening (using a Teflon thread compound such as Loctite pipe sealant) so that the entire electrode is immersed in the measured solution. Allow at least 1/2-inch clearance beyond the end of the cell. In applications where vertical mounting is required, avoid a position with the cell channels pointed up, as this will permit solution to flow down into the open end of the cell and may result in clogging by solids settling in the cell channels. See Fig. 3.

4. ELECTRICAL CONNECTIONS

The terminal-board connections for recorder or monitor are given in the appropriate directions furnished with the measuring instrument. Fig. 4 illustrates these connections and shows the cells internal arrangement.

When the cell assembly includes a built-in temperature compensator, there are three leads; black, red, and white. The cell (and a series compensator for non-linear ranges) is connected between black and white and the compensator is between red and white. At the 7070-07 Monitor terminal board, connect black to CELL 1, red to TEMP COMP A and white to TEMP COMP B. The terminal board of a 7075 or 7073-17 Monitor is marked according to the color convention used in this cell cable. At a recorder terminal board, connect black to A, red to B, and white to C.

When a compensator is not built into the cell assembly, only two leads are used; black and white. For the 7070-06 or -07 Monitors, connect the black to CELL 1 and the white to CELL 2. For the 7075 and 7073-17 Conductivity Monitors, follow the color designations. The red lead is not connected.

To avoid the possibility of ac pickup in the cell leads, separate them from all ac line-voltage wiring or run them in a separate grounded conduit.

5. MAINTENANCE

The only maintenance which may be required is occasional cleaning in certain applications. The low-constant electrodes are not platinized. Note that a series of below-normal conductivity readings could indicate a lack of response because the cell is not filled with solution. Cell constants 0.01, 0.1, and 1 cannot be used if solution resistance measures less than 1000 ohms unless the cell is platinized in accordance with Appendix B.

5A. To Clean The Cell

The cell will require cleaning if sludge, slime, etc., accumulates in the flow channels. Since the materials of construction are chemically inert, chemical agents may be used and are recommended for cleaning the cells. The particular cleaning agent used must be selected according to the type of contamination to which the cell is exposed. In general, a "quick" rinse in a 10% inorganic acid is effective and adequate. If necessary, a soft bristle brush of about 1/4" diameter may be used to clean out the tubular channels of the 5, 10, 20, 25 and 50 constant cells. Care must be taken not to scratch the electrode surfaces. Do not use a brush on the low (0.01, 0.1 and 1) constant cells and be especially careful not to bend the

* Flow-cell housing can be used "in-line" only if restriction of cell itself can be tolerated.

TABLE II – STANDARD REFERENCE SOLUTIONS

Approximate Normality	Definition	Temp. °C.	Specific Conductance (micromhos)	Nominal Constant of Cell To Be Checked
1.0 N	71.1352 grams KCl per 1000 grams of solution	0 18 25	65,176 97,838 111,342	50, 25, 10, 5, 20,

E2340

electrode plates of the 0.1 constant cell. Rinse the cell thoroughly in tap water and then in distilled water if available.

5B. To Check Conductivity System

To check the conductivity system comprising conductivity cell, leadwire, and measuring instrument, the user may desire to make a measurement in a reference solution of known conductivity. Table II defines the standard solutions for 5 to 50 constant cells only, and lists their conductivity. Control the temperature only within limits consistent with the desired accuracy. The 25 °C temperature value is suggested. The solutions may be prepared in the presence of air. The solution must fill the cell during measurement.

To check the constant of a cell, use a second cell having the same constant and compare the reading of one against the other.

5C. Replacement Parts And Accessories

DESCRIPTION	PART NUMBER
Cell Guard Tube (1, 0.1, and 0.01 constants only)	265746
Leadwire Bushing	006965
Flow Cell Housing	276127
1-1/4" to 1" Bushing to adapt cell to 1-1/4" Schedule 80 pipe tee	276142
Cable to extend cell leads	18-34-48
Junction Box	316274
Tube of Loctite pipe sealant	083053
Adapter bushings for connecting the flow cell housing in 1/4-inch bypass line	
3/4" male to 1/4" female	276315
3/4" female to 1/4" female	276316

NOTE: The conductivity cell and the mounting bushing (with temperature compensator) cannot be separated. For replacement of either cell or integral compensator, order the appropriate 4905 catalog number specified in Table I, completing suffix C by reference to Tables III, IV, and V.

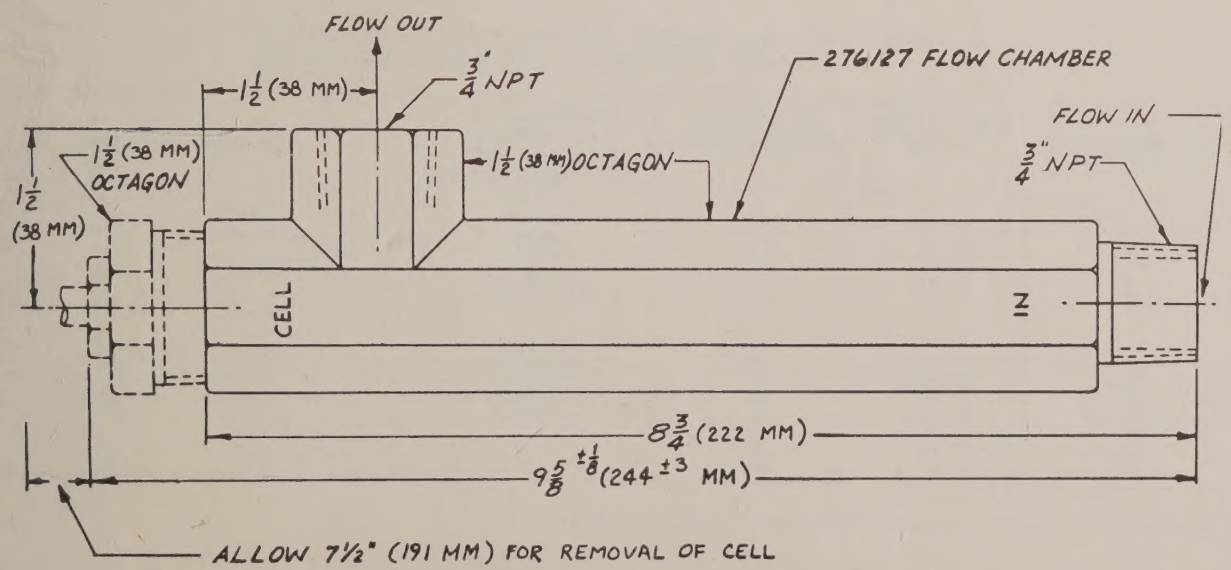


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Fig. 6 – Dimension drawing for 276127 Flow Housing.

APPENDIX A

AUTOMATIC TEMPERATURE COMPENSATOR DATA

Conductivity measurements are always corrected to an appropriate reference temperature and the temperature compensator is designed accordingly. The value of conductivity on which this compensator design is based is the compensator reference-conductivity. Usually the compensator is built into the conductivity cell assembly. If so, the compensator range suffix in Tables III, IV, and V is a part of the cell-assembly required for that range. The cell constant must also be known to specify the 4905 Cell Assembly.

Because the temperature vs. conductivity relationship remains the same above 2 micromhos for most solutions, this value of compensator reference-conductivity is used for most of the higher micromho ranges. For the concentration ranges, a compensator curve referenced to a particular concentration is used.

Identification and characteristics of both integral and separate compensators used with the 4905 Conductivity Cell Assembly are tabulated in Tables III, IV, and V.

TABLE III – AUTOMATIC TEMPERATURE COMPENSATORS FOR 7070-07 CONDUCTIVITY MONITORS

CELL ASSEMBLY 3rd SUFFIX *	TEMPERATURE RANGE °C	REFERENCE TEMPERATURE °C	COMPENSATOR REFERENCE CONDUCTIVITY or CONCENTRATION	Used with these 7070-07 Monitors (Cat. Suffix E)
–026	10–60	25	2	-015, -025, -026, -030, -037, -040, -054, -055
–088	0–100	25	2	-011 to -014, -050 to -053, -021 to -024, -032 to -036
–090	0–60	25	0.5	-016
–091	0–60	25	2	-016
–092	0–60	25	2	-056
–093	0–60	25	0.1	-016
–113	0–100	25	0.1	-010
–114	0–100	25	0.5	-010
–127	30–70	50	800 ppm	-043

*Also first suffix of separate temperature compensator Catalog 4982, 4983 or 4986.

TABLE IV – AUTOMATIC TEMPERATURE COMPENSATORS FOR SPEEDOMAX G, H, AND W RECORDERS

CELL ASSEMBLY 3rd SUFFIX *	TEMPERATURE RANGE °C	REFERENCE TEMPERATURE °C	COMPENSATOR REFERENCE CONDUCTIVITY or CONCENTRATION	RECORDER RANGES
–009	10–100	25	10 µmhos	2 µmhos and above
–009	2–50	25	1 µmhos	10 µmhos and below
–010	25–100	25	1 µmhos	10 µmhos and below
–013	0–50	25	0.5 µmhos	10 µmhos and below
–014	0–60	25	0.5 µmhos	nonlinear 0 to 10 µmhos
–057	2–36	25	100 µmhos	2 µmhos and above (river water)
–070	0–60	25	0.1 µmhos	nonlinear 0 to 1 µmhos
–071	0–60	25	10 µmhos	0 to 100 µmhos
–072	0–60	25	100 µmhos	0 to 1000 µmhos
–073	16–82	25	3%	0.5 to 6% NaOH
–074	10–82	25	5%	1 to 12% H_2SO_4

*Also first suffix of separate temperature compensator Catalog 4982, 4983, or 4986.

TABLE V – AUTOMATIC TEMPERATURE COMPENSATOR FOR 7073-17 AND 7075-1, -2 CONDUCTIVITY MONITORS

Cell Assembly 3rd Suffix*	Temperature Range °C	Reference Temperature °C	Compensator Reference Conductivity or Concentration	Used with these 7073-17 Monitors (Cat. Suffix C)	Used with these 7075-1, -2 Monitors (Cat. Suffix B)
088	0-100	25	2	101-106,200-205,250-255 500-505,510-516,520-525 550-555	021 (0-2,0-20,0-200,0-2000 µmhos) 011 (0-10,0-100,0-1000 µmhos) 052 (0-500,0-5000 µmhos)
090	10-90	25	0.5	111	111 (0-10 µmhos)
091	0-60	25	2	111,112,113,114	111 (0-10,0-100,0-1000,0-10000 µmhos)
092	0-60	25		561-564	152 (0-500,0-5000,0-50000 µmhos)
093	0-100	25	.1	111	111 (0-10 µmhos)
113	0-100	25		100	011 (0-1 µmhos)
114	10-90	25		100	011 (0-1 µmhos) 021 (0-2 µmhos)
141	10-90	25	.5	211	
143	0-60	25	2	210,211,212,213,214	
138	0-100	25	10 megs.	018	018 (.1-18 megs.)
140	0-100	25	1.8 megs.	018,019 (resistance)	018 (.1-18 megs, .01-1.8 megs)
140	0-38	25	.5 megs.	118,119 (resistance)	118 (1-180 k, .1-18 k)
074	10-82	25		604,605,606,607(H_2SO_4)	
073	16-82	25	3%	640 (NaOH)	
073	16-50	25	6%	641 (NaOH)	
009	0-40	25	2%	660 (NaOH)	
009	0-100	25		670,671,672,673 (NaCl)	
164	2-25	25	5% Hcl	656	
160	10-50	25	4% Hcl	656	
164	2-25	25	5% Hcl	655	
160	10-50	25	4% Hcl	655	

*Also first suffix of separate temperature compensator Catalog 4982, 4983 or 4986.

APPENDIX B

PLATINIZATION AND PLATINUM BLACK

TO REMOVE PLATINUM BLACK (4905-44 ONLY)

If it is desired to remove the platinum black from the electrodes, place the cell in a beaker containing aqua regia (after removing the guard tube from the low constant cells) and connect a 1.5 volt dry cell to the conductivity cell leadwires. After a short interval, reverse the dry cell connections to the leadwires. Continue alternating these connections until the platinum black is removed. This is indicated by the appearance of the bright metal of the electrodes. It is difficult to observe the condition of the electrodes on the high constant cells. Some indication is given by placing a strip of white paper in the cross-channel, shining a light into the cross-channel, and looking into the flow channels from the other end.

CAUTION: Aqua regia is a solvent for gold and platinum and will, over an extended period of time, dissolve the entire electrode. The above procedure should be carried out cautiously and only when needed. Do not use aqua regia for gold-plated electrodes.

When all platinum black is removed, rinse the cell thoroughly with distilled water.

TO PLATINIZE

Only the electrodes having constants from 5 to 50 must be platinized if the velvety-black deposit has been rubbed off the electrodes in service or in cleaning or if platinized electrodes are recommended and this black deposit is not present when the new cell is received. Always replatinize if a brush was used in cleaning the electrodes. The indication of a need for replatinization of the electrodes is loss in sensitivity (slow response of measuring instrument), erratic behavior of measuring instrument, or difficulty in balancing. The electrodes of the high constant cells are not visible since they are located near the middle of the flow channels. Therefore the need for platinization is only indicated by the effect on the measuring instrument.

Support the cell in a cylindrical vessel with the end of the cell raised from the bottom. It is not necessary to remove the cell from the fittings for platinizing. However, the guard tube must be removed from the low constant cells. Pour in platinizing solution (L&N Part Std. 1192-3) to a level above the cross-channel.

To platinize the 5, 10, 20, 25 and 50 constant cells, immerse an auxiliary platinum electrode* in the solution to a point about midway between the cross-channel or tube hole and the open end of the cell. Both electrodes of the cell are platinized simultaneously by connecting the negative terminal of the battery (see Table VI for voltage) to both leadwires of the cell. Connect the positive terminal of the battery, to the auxiliary platinum electrode. Note the time lapse and continue the platinizing operation for the time in seconds listed in Table VI. Then disconnect the battery and remove the cell. Rinse the cell thoroughly in tap water and then rinse in distilled water. During the platinizing operation, move the cell up and down gently to keep the solution stirred.

CAUTION: The preceding procedure produces a barely visible coating of platinum black on the electrode surfaces. Do NOT attempt to darken electrodes by additional platinization since this will affect cell performance adversely.

Pour the platinizing solution back into its container as it may be used a number of times.

If the cell is not to be installed immediately after platinizing, it should be kept submerged in distilled water until put into use, as platinum black is not stable when dry.

TABLE VI – VOLTAGE AND TIME LIMITS FOR PLATINIZING CELLS

	CELL CONSTANTS							
DC VOLTAGE	.01	.1	1	5	10	20	25	50
1.5	–	160 sec.	150 sec.	–	–	–	–	–
3.0	2 sec.	60 sec.	30 sec.	200 sec.	240 sec.	–	–	–
6.0	–	–	–	80 sec.	100 sec.	180 sec.	200 sec.	300 sec.
12.0	–	–	–	–	–	120 sec.	150 sec.	240 sec.

*This third electrode should be chemically pure platinum. Its shape is unimportant. It may be one of the electrodes in another conductivity cell or a platinum strip, sheet, rod, wire, etc.

4905-10-33-088-7

L&N FIELD OFFICES

AL, Birmingham
AL, Mobile
AZ, Phoenix
CA, Los Angeles (Anaheim)
CA, San Francisco (San Mateo)
CO, Denver
CT, Hartford (Avon)
DE, Wilmington
DC, Washington (Columbia)
FL, Miami (Deerfield Beach)
FL, Orlando
GA, Atlanta
IL, Chicago (Rosemont)
IL, Lansing
IN, Indianapolis
IA, Davenport (Bettendorf)
KS, Kansas City (Mission)
KY, Louisville
LA, Baton Rouge
LA, Shreveport
MD, Baltimore (Columbia)
MA, Boston (Dedham)
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MI, Grand Rapids
MN, Minneapolis
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MO, St. Louis (Clayton)
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NJ, Union
NY, Albany (Latham)
NY, Buffalo
NY, New York
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NY, Syracuse
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OH, Akron (Canton)
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OH, Cincinnati
OH, Cleveland
OH, Columbus
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PA, Philadelphia (Fort Washington)
PA, Pittsburgh
PA, Sharon
SC, Columbia
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TX, Houston
UT, Salt Lake City
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